

REMARKS

The Specification has been amended. Claims 3, 8, 9, 13, 18, and 19 have been amended. Claims 28, and 51-60 have been cancelled. Claims 1-27 and 29-50 remain in the application, although claims 20-27 and 29-50 have been withdrawn from consideration. Further examination and reconsideration of the application, as amended, is hereby requested.

RESTRICTION REQUIREMENT

In Sections 1-12 of the Office Action, the Examiner restricted the application into multiple groups of claims.

	<u>Group</u>	<u>Claims</u>	<u>Class</u>	<u>Subclass</u>
	I	1-50	257	10
	III	1-27	257	10
		Separate Species 1, 20, 22, 23-24, 25, 26, 27 (claim 1 is generic)		
	IV	28	313	364+
	V	33-38	250	310
		Separate Species 33, 34, 35, 36, 37, 38 (claim 33 is generic)		
	VI	39-50	315	169.3
	II	51-60	438	20

## Note:

III and IV are related as combination and sub-combination

III and V are related as combination and sub-combination

I and VI are related as combination and sub-combination

(Claims 29-32 have not been restricted further from Group I).

Applicants respectfully traverse the restriction requirement but provisionally affirm the election of claims 1-19 of group I. Applicants have cancelled claims 28 and 51-60 of Groups IV and II, respectively, but maintain that claim 1 is generic and that claim 1 is patentable over the art made of record as discussed below. In addition, Applicants believe claims 29-32 are still within Group I and include the same limitations as claim 1 and accordingly are patentable over the art made of record. Group V is a combination of sub-combination Group III and thus is

believed patentable based on the patentability of Group III. Accordingly, Applicants believe that the restriction between groups I and III and the further restriction of group V from group III is in error and should be withdrawn. Such withdrawal is respectfully requested.

5

#### REJECTIONS UNDER 35 USC 112

In Section 14 of the Office Action, the Examiner rejected claim 7 under 35  
 10 USC 112 1<sup>st</sup> Paragraph as failing to comply with the enablement requirement. In  
 particular the Examiner stated that the claimed subject matter was not described  
 in the specification in such a way as to enable one skilled in the art ... to make  
 and use the invention. The Examiner stated that "a 2% efficiency is claimed but  
 such is not supported by the specification and the specification does not indicate  
 15 how such an efficiency can be achieved." Applicants respectfully traverse this  
 rejection. On page 8, lines 23-28 states that "Using the architecture of the  
 invention, the emitting surface for flat tunneling emitters has an electron emission  
 rate of about 2 to about 8.0 Amps per square centimeter with an efficiency of  
 about 1 to about 8 percent (*preferably at least 2 percent* which is far greater than  
 20 the 0.1 percent efficiency of conventional flat tunneling emitters) dependent on the  
 actual design choices selected for the flat tunneling emitters fabricated."  
 Therefore there is support in the specification for this limitation and it is enabled by  
 description of the invention in the specification which clearly states that including  
 the anisotropic conductivity layer allows for uniform distribution of the emission  
 25 sites across the emitter surface (page 9, lines 2-10). The anisotropic layer  
 distributes the applied voltage to each of the emission sites more uniformly thus  
 allowing for more electron emission which increases the electron efficiency (see  
 page 15, lines 14-26). The Applicants describe several embodiments on how to  
 make and use the invention, and although a theory of operation is not required,  
 30 Applicants have disclosed the basic principle of the invention. The actual  
 efficiency will be determined by many design factors. However, by incorporating  
 the anisotropic conductivity layer, the efficiency results over the conventional flat  
 tunneling design is improved by greater than an one and possibly two orders of  
 magnitude. Withdrawal of this rejection is respectfully requested.

35

In Section 16 of the Office Action, the Examiner rejected claims 1-19 under  
 35 USC 112, 2<sup>nd</sup> paragraph as being indefinite for failing to particularly point out

and distinctly claim the subject matter which the Applicants regard as the invention.

In particular the Examiner states, "claim 1 refers to sheet resistance but it appears that resistivity is intended." Applicants respectfully traverse this rejection. Resistivity is the inverse of conductivity. Conductivity is defined as the current density divided by the applied electric field. Resistivity is a strong function of depth and thus "sheet resistance" which is defined as the resistivity divided by the thickness. Therefore, having an anisotropic (a directionally dependent phenomenon) sheet resistance would mean that the sheet resistance varies in a directionally dependent manner. This anisotropic sheet resistance definition is just stating that the material property has a resistance in the thickness that is different than the resistance in the length and width directions (see page 6, lines 11-20). Withdrawal of this rejection under 35 USC 112 2<sup>nd</sup> para. for claim 1 is respectfully requested.

In particular for claim 8, the Examiner states that the "resistivity in the thickness direction as being larger than half the resistivity in the length and width directions" and "is this intended"? Applicants have amended claim 8 to more clearly defined their invention. Claim 8 now states that the "the sheet resistivity of the anisotropic conductivity layer in the thickness direction *is less than* the sheet resistivity of the anisotropic conductivity layer in the length and width directions *by about at least 2 times*." Support for this change is found throughout the specification and in particular on page 6, lines 17-20. Withdrawal of this rejection under 35 USC 112 2<sup>nd</sup> para. for claim 8 is respectfully requested.

In particular for claim 10, the Examiner states that claim 10 refers to the layer as being self organized and that "this is not understood and there is no support for a specific mechanism to create this self organization." Applicants respectfully traverse this assertion. The specification on page 12, lines 8-11 states that "The emission sites included in the anisotropic conductivity layer may be either a self-organized or chaotic array (formed by the process or material used) or and artificially assembled array (such as formed by patterned masks)". 'Self-organized' is a term of the semi-conductor art that means regular structures are formed by the material itself without using patterned masks to create the structures. Several different processes to create self-organized arrays include page 16, lines 19-28 (granular crystalline structure of amorphous silicon), page 18, lines 20-28 (polysilicon large granular structure), page 19, lines 3-9 (average grain size larger than thickness of material), and page 19, lines 15-23 (organized crystalline structure of sputtered material). Withdrawal of this rejection under 35 USC 112 2<sup>nd</sup> para. for claim 10 is respectfully requested.

In particular for claim 18, the Examiner states that claim 18 “refers to the conductivity as being greater than that of the substrate. What direction of conductivity does this refer to”? Claim 18 is referring to the embodiment described in Figs. 13A-C (page 18, lines 7-14) which is an extension of that described in Figs. 12A-C (page 17, line 23 –page 18 line 6). The epitaxial layer has a lower resistance and thus a higher conductivity than the substrate. The substrate would be in the X-Y direction and the epitaxial layer is in the Z direction. This direction is thus inherent in the fabrication of the device. However, Applicants have amended Claim 18 to more clearly define their invention. Claim 18 now states that “the anisotropic conductivity layer comprises a patterned or structured semiconductor epitaxial layer having *low resistance sites surrounded by a resistive back material.*” Support for this change is found on page 18, lines 7-14. Withdrawal of this rejection under 35 USC 112 2<sup>nd</sup> para. for claim 18 is respectfully requested.

#### REJECTIONS UNDER 35 USC 102

In Section 22 of the Office Action, claims 1, 2, 4, 5, 12, and 17 were rejected under 35 USC 102(b) as being anticipated by Tsukamoto et al. Applicants respectfully traverse this rejection. In order to anticipate, a single reference must disclose all of the elements of the claimed invention, *arranged as in the claim*. Claim 1 reads:

1. An emitter, comprising:  
an electron source;  
a cathode having an emissive surface; and  
a continuous anisotropic conductivity layer *disposed between the electron source and the emissive surface of the cathode* wherein the anisotropic conductivity layer has an anisotropic sheet resistance profile.

Fig. 2A of Tsukamoto is shown below. Fig. 1 of Applicant's spec. is shown below

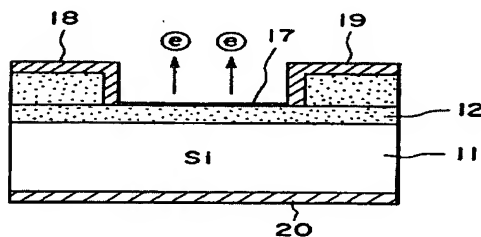


FIG. 2A

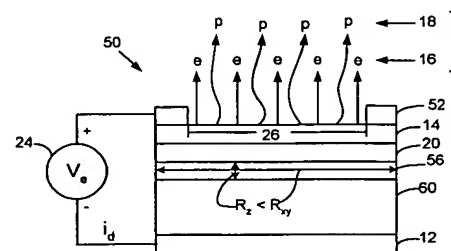


Fig. 1

The Examiner states that Tsukamoto shows electron source 11, continuous anisotropic layer 17 and cathode 17, 18, 19. However, Tsukamoto does not show the continuous anisotropic conductivity (CAC) layer 17 *disposed between* the electron source and the emissive surface of the cathode but rather that the CAC layer 17 is the *emissive surface itself* and is part of the cathode surface. CAC layer 17 in Tsukamoto is disposed between the two other cathode segments 18 and 19 and not “between the electron source and the emissive surface of the cathode” as the Applicants are claiming. Claim 1 is believed patentable over Tsukamoto as Tsukamoto does not disclose, teach, or suggest the claim elements as arranged in the claim.

With respect to claim 2, the Applicants are claiming a “tunneling layer disposed between the anisotropic conductivity layer and the cathode.” Tsukamoto discloses the tunneling layer between the electron source and the anisotropic conductivity layer. Tsukamoto is using the anisotropic conductivity layer as an emission surface while the Applicants are using the anisotropic conductivity layer to make the emissions over the surface of the device more uniform and consistent (see page 9 lines 2-10). Therefore Tsukamoto does not disclose, teach, or suggest claim 2 in the arrangement as cited in the claim and therefore does not anticipate it.

With respect to claim 4, while structures 21 are equivalent to Spindt tips as the Examiner states, the Applicants are claiming that the “cathode layer includes an array of Spindt tips” not the anisotropic conductivity layer. It is the Examiner reordering the elements of Applicants invention to make the anisotropic conductivity layer part of the cathode layer that is required to make the anticipation argument while the Applicant is not claiming such. The Applicant is claiming that the anisotropic conductivity layer is “disposed between the electron source and the cathode layer” and not that the anisotropic conductivity layer is part of the cathode layer itself. Accordingly, Tsukamoto does not disclose, teach, or suggest Applicants claimed invention as arranged and therefore does not anticipate it.

With respect to claim 5, claim 5 is believed patentable based at least on the patentability of claims 1 and 4 from which it depends.

With respect to claim 12, while Tsukamoto discloses that its structures are poly, Applicants are claiming an additional “polysilicon layer having a plurality of

nodules disposed between the anisotropic conductivity layer and the cathode.”  
Tsukamoto just discloses that anisotropic conductivity layer begins as a polysilicon layer that is heated to crystallize the poly locally in the aluminum area. Accordingly, Tsukamoto does not disclose, teach, or suggest Applicants claimed invention as arranged in claim 12 and therefore does not anticipate it.

With respect to claim 17, claim 17 is believed patentable based at least on the patentability of claim 1 from which it depends.

Withdrawal of the rejection under 35 USC 102(b) for claims 1, 2, 4, 5, 12, and 17 and their allowance is respectfully requested.

#### CLAIM REJECTIONS UNDER 35 USC 103

In Section 30 of the Office Action, the Examiner rejected claim 7 under 35 USC 103(a) as being unpatentable over Tsukamoto. The Examiner states that while Tsukamoto does not specify the efficiency, it would be obvious to design the device to produce high efficiency, specifically greater than 2%. Applicants respectfully traverse this statement. As stated in the specification on page 2, conventional tunneling emitters have efficiencies of less than 0.1 percent. The Examiner does not state how Tsukamoto would be modified to increase this efficiency to greater than 2%. As the applicants state on page 9 lines 2-10, by incorporating the anisotropic conductivity layer between the electron source and the cathode layer, it distributes the emissions uniformly over the emission surface to prevent “beetle gallery” formations. See also page 8 lines 23-28 for the Applicants’ invention efficiency gain. It is unclear how Tsukamoto solves this issue by its disclosure nor does the Examiner make a reasoned argument either. The Examiner has simply made an assertion that it would be easy to do so without supporting reasoning. There is no anisotropic conductivity layer between the electron source and the cathode surface in Tsukamoto as the Applicants are claiming but rather the layer 17 of Tsukamoto is used as the emission surface itself. Accordingly, claim 7 is not disclosed, taught, or suggested by Tsukamoto. Withdrawal of the

rejection under 35 USC 103(a) and allowance of claim 7 is respectfully requested.

In Section 32 of the Office Action, the Examiner rejected claims 6, 8, 10, 11, 16 and 18 under 35 USC 103(a) as being unpatentable over Tsukamoto in view of Kumar and Yamamoto. Claims 6, 8, 10, 11 and 18 are believed patentable based at least on the patentability of claim 1 from which they depend. Claim 16 is believed patentable based at least upon the patentability of claims 1, 13, and 14 from which it depends. Withdrawal of the rejection under 35 USC 103(a) and allowance of claims 6, 8, 10, 11, 16, and 18 is respectfully requested.

#### WITHDRAWN CLAIMS

Claims 20-27 depend on claim 1 directly or indirectly and are believed patentable based at least on the patentability of claim 1 which is generic. Further reconsideration and allowance of claims 20-27 is requested.

Claim 28 has been cancelled.

Claims 29-32 belong to Group I and are believed patentable for the reasons stated previously for claim 1. Applicants believe that claim 29 is directed to the same class of invention as claim 1 and thus is allowable based at least on the allowability of claim 1. Tsukamoto does not disclose an emission layer disposed on the anisotropic conductivity layer and a cathode layer disposed on the emission layer. Accordingly, claims 29-32 are believed patentable and further reconsideration and their allowance is respectfully requested.

Claims 33-38 belong to group V and contain the same limitations as claim 1 (Group I and III) and requires the particulars of the sub-combination and thus are believed patentable for the same reasons as stated for claim 1

above. Further reconsideration and allowance of claims 33-38 is respectfully requested.

Claims 39-50 belong to group VI contain the same limitations as claim 1 (Group I) and requires the particulars of the sub-combination and thus are believed patentable for the same reasons as stated for claim 1 above. Further reconsideration and allowance of claims 39-50 is respectfully requested.

The prior art made of record but not relied upon by the Examiner has been reviewed, but is no more pertinent to Applicants' invention than the cited references for the reasons given above.

Applicants believe their claims as amended are patentable over the art of record, and that the amendments made herein are within the scope of a search properly conducted under the provisions of MPEP 904.02. Accordingly, claims 1-19 are deemed to be in condition for allowance, and such allowance is respectfully requested. Additionally claims 20-27 and 29-50 are believed to be improperly restricted and their reconsideration and allowance are respectfully requested.


If for any reason the Examiner finds the Application other than in a condition for allowance, the Examiner is respectfully requested to call Applicants' undersigned representative at the number listed below to discuss the steps necessary for placing the application in condition for allowance.

The Commissioner is hereby authorized to charge any additional fees which may be required, or credit any overpayment to Deposit Account No. 08-2025. Should such fees be associated with an extension of time, Applicants respectfully request that this paper be considered a petition therefore.

Hewlett-Packard Company  
Legal Department  
1000 NE Circle Blvd.  
Corvallis, OR 97330  
Telephone: (541)715-4197  
Fax: (541)715-8581

Respectfully Submitted,

A. Govyadinov

By: 

Timothy F. Myers

Patent Attorney

Registration No. 42,919